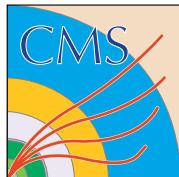




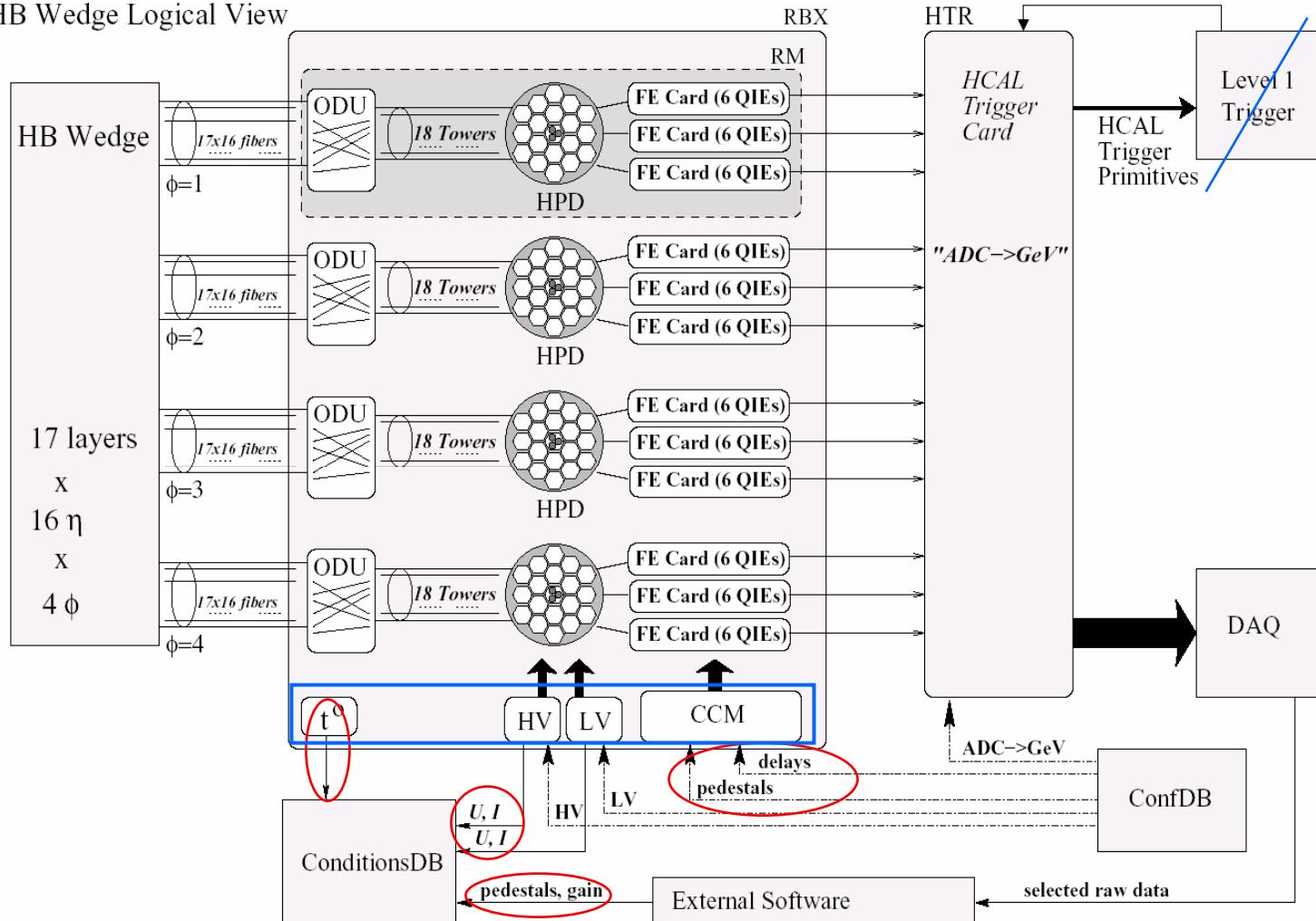
HCAL DCS

**Shuichi Kunori
U of Maryland
06-Mar-2006**

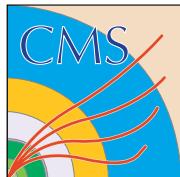


HCAL Readout

HB Wedge Logical View



Stefan Piperov



Configuration setting and read back by DCS

HCAL FE Parameters

- **3 main run modes**

- Source calibration mode (HCAL partitioned, local R/O)
- Laser-to-HPD calibration mode
- Normal (beam) mode

- **132 RBX having ~ 100 bytes of settings each**

- TTC Rx

- <32 bytes of setting, not used now

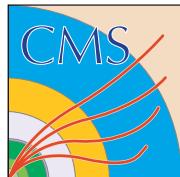
- **4 RMs having**

- 18 FE channels with 3 bit pedestal + 5 bit delay
 - HV and BV for HPD (10 bit each)

This gives 13.2 Kbytes per run mode or

In total ~ $3 \times 132 \times 100 < 50$ KBytes

Store the setting and read back in Conditions DB per run.



HCAL Monitor by DCS

Information from Segej Sergueev

During the normal data taking the HCAL DCS will monitor following values

Per each HPD

HV, BV, Ihv, Ibv - single precision floats (4 bytes),
1 byte of status.

In total 17 bytes * 108 RBXs * 4 RMs = 7344

Per each group of HF PMTs

HV, Ihv - single precision floats (4 bytes),
1 byte of status.

In total 9 bytes * 48 (?) groups = 432 bytes

Per each RBX

low voltage values LV1, LV2 - single precision floats (4 bytes),
temperatures T1,T2,T3,T4,T5 - single precision floats (4 bytes),
CCM status + error bytes,

In total 30 bytes * 132 = 3960

Per each HV module

2 HV module status bytes
In total 108+48*2= 312 bytes

This gives 12048 bytes per measurement. Measurements could follow with maximum rate 1 Hz.

I think we could suppress this data flow by applying of the "Dead band" filtering for data change (as it is called in PVSS) by sending only data having difference from previous measurement more than given "dead band" value. For example if to apply 5% of "dead band" we will reduce data flow more than 10 times.

Regards
Sergej

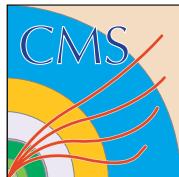
HPD/PMT HV, LV
QIE LV
Temp. etc.

~12kbytes/meas @ 1Hz max.

~20Mbytes/day @ 1/60 Hz

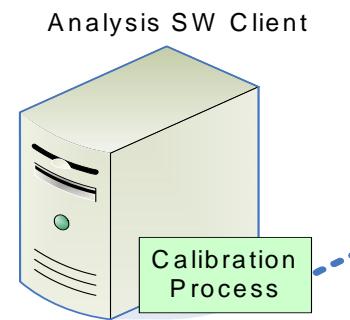
**Not much data, but it may pileup...
And never look at...**

**Need to store them in different partition
for easy archival and removal.**



Dataflow diagram

Calibration



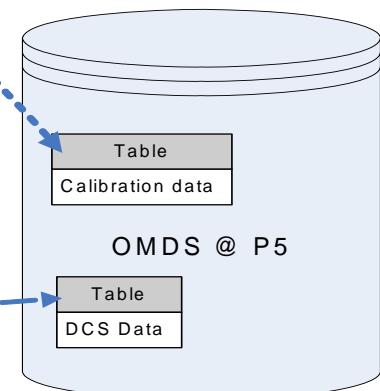
XML Loader Server

XML data

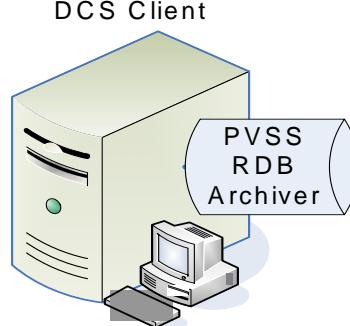
XML
Loader

spool directory

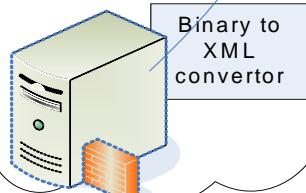
Database Server



Monitoring



Monitoring Client
(backup solution)



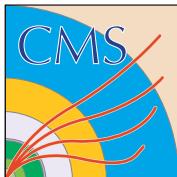
Tasks:

DB schema (Yuyi, G., Lee, L, Shuichi K., G.L.)

XML Loader (Yuyi G., G. L.)

DCS Monitoring (Sergey. S., G.L.)

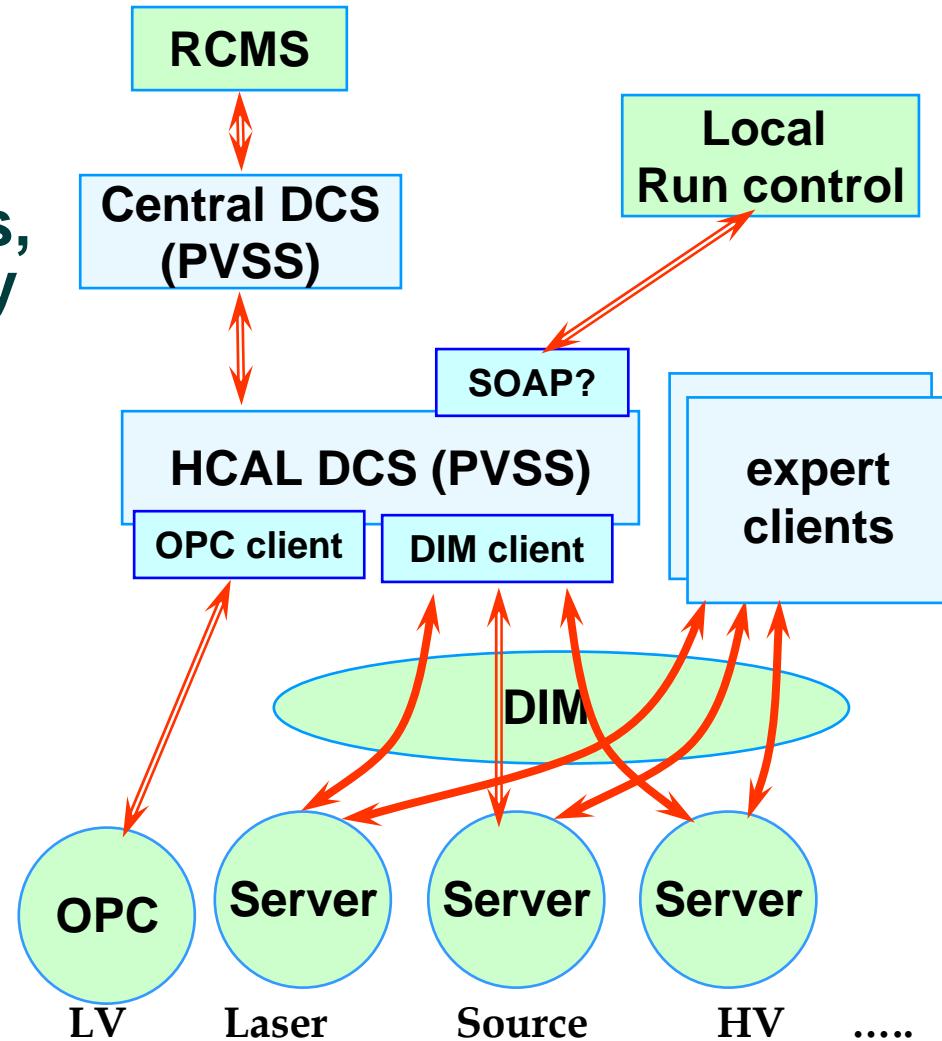
C++ to Oracle interface (Fedor R., G.L.)

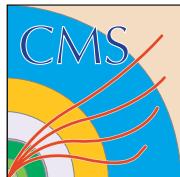


HCAL DCS Architecture

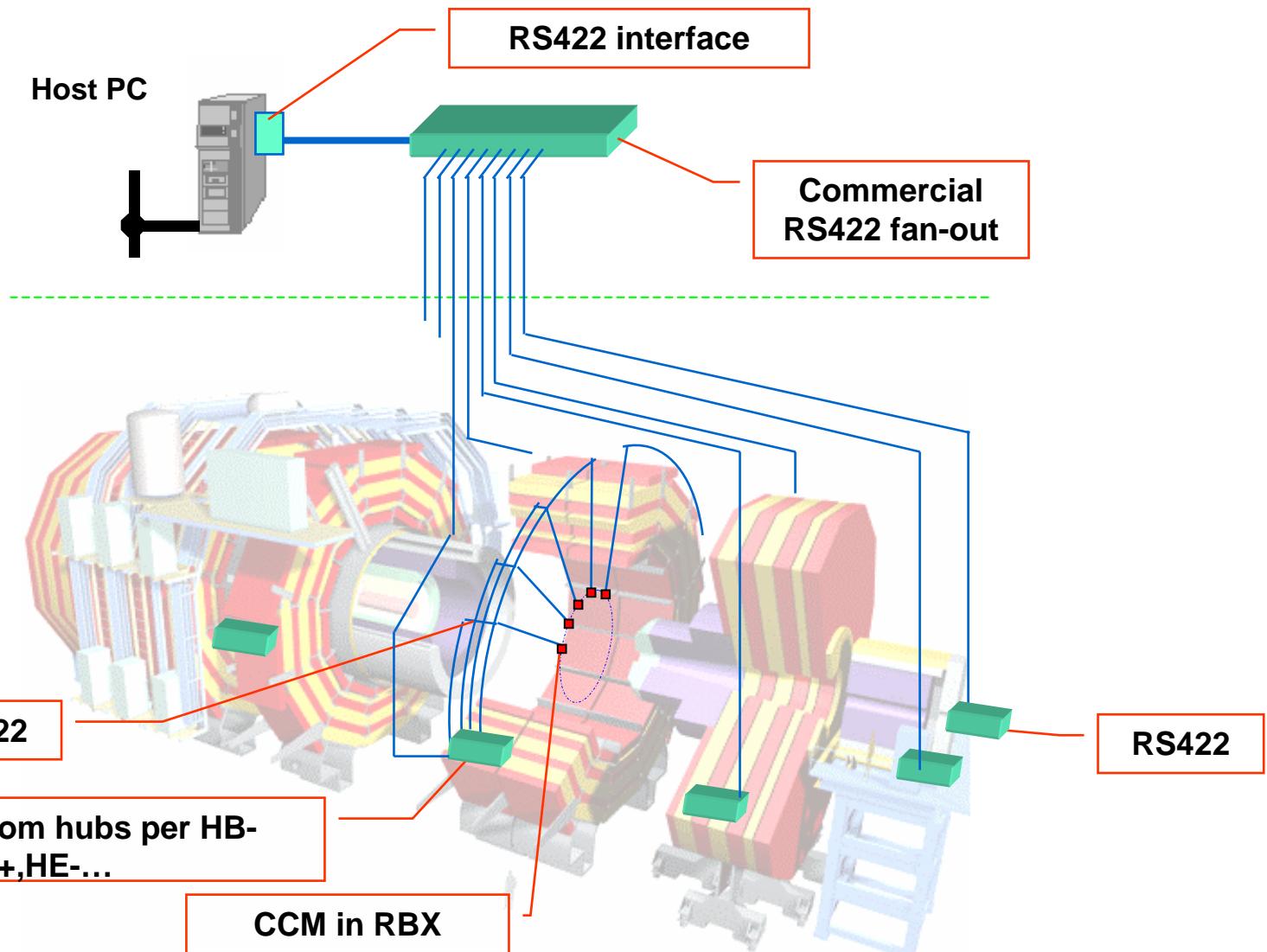
FNAL/JINR (Sergueev)

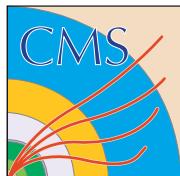
- Heterogeneous components: drivers, OS, hardware protocols, trigger types are mostly different.
- Each system has a uniform interface with DCS through a DIM server (except LV)
- Expert clients for diagnostics, etc.
- PVSS + JCOP FW as main control toolkit





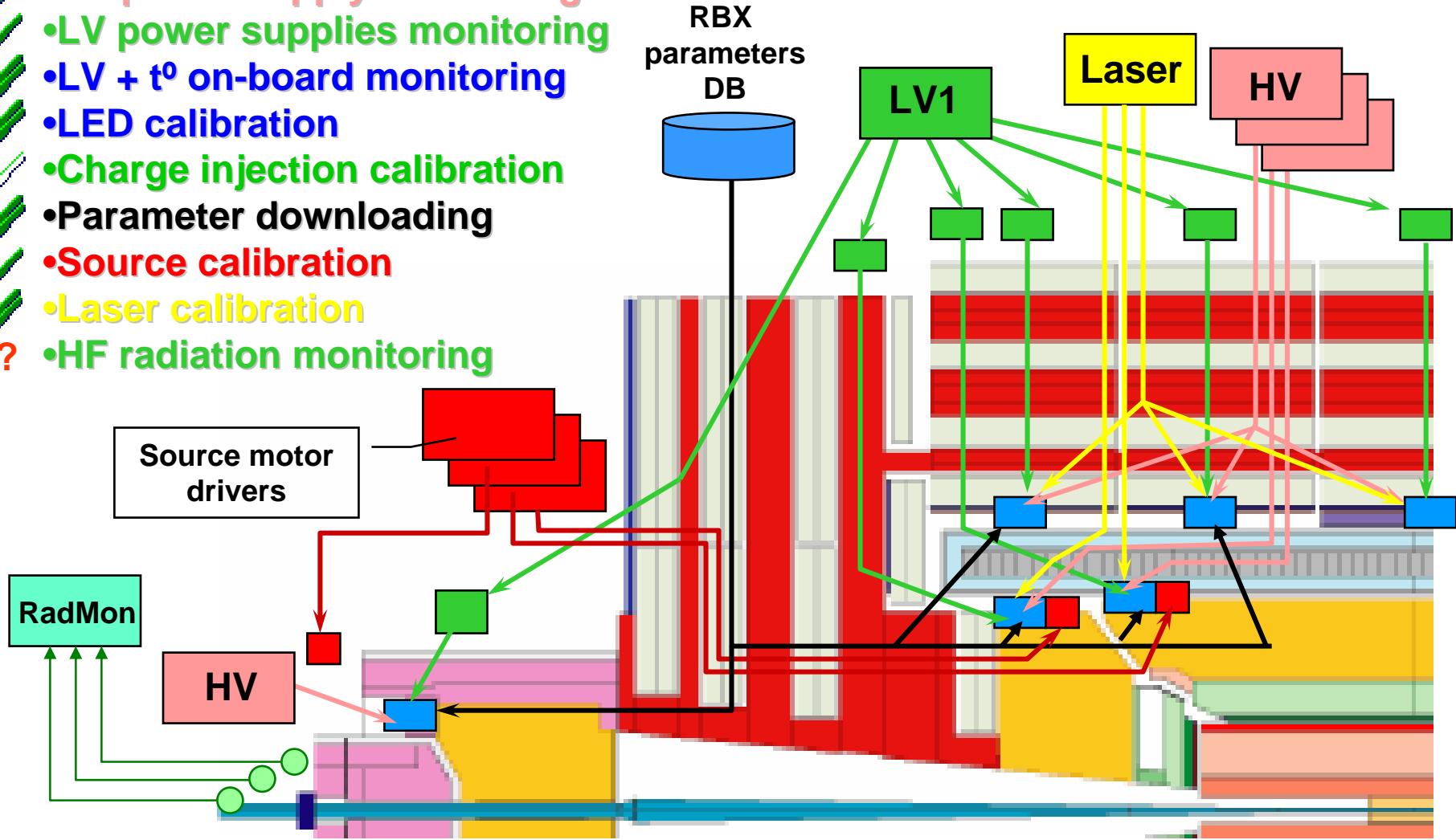
Communication Hardware

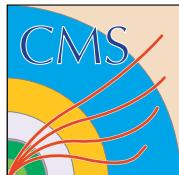




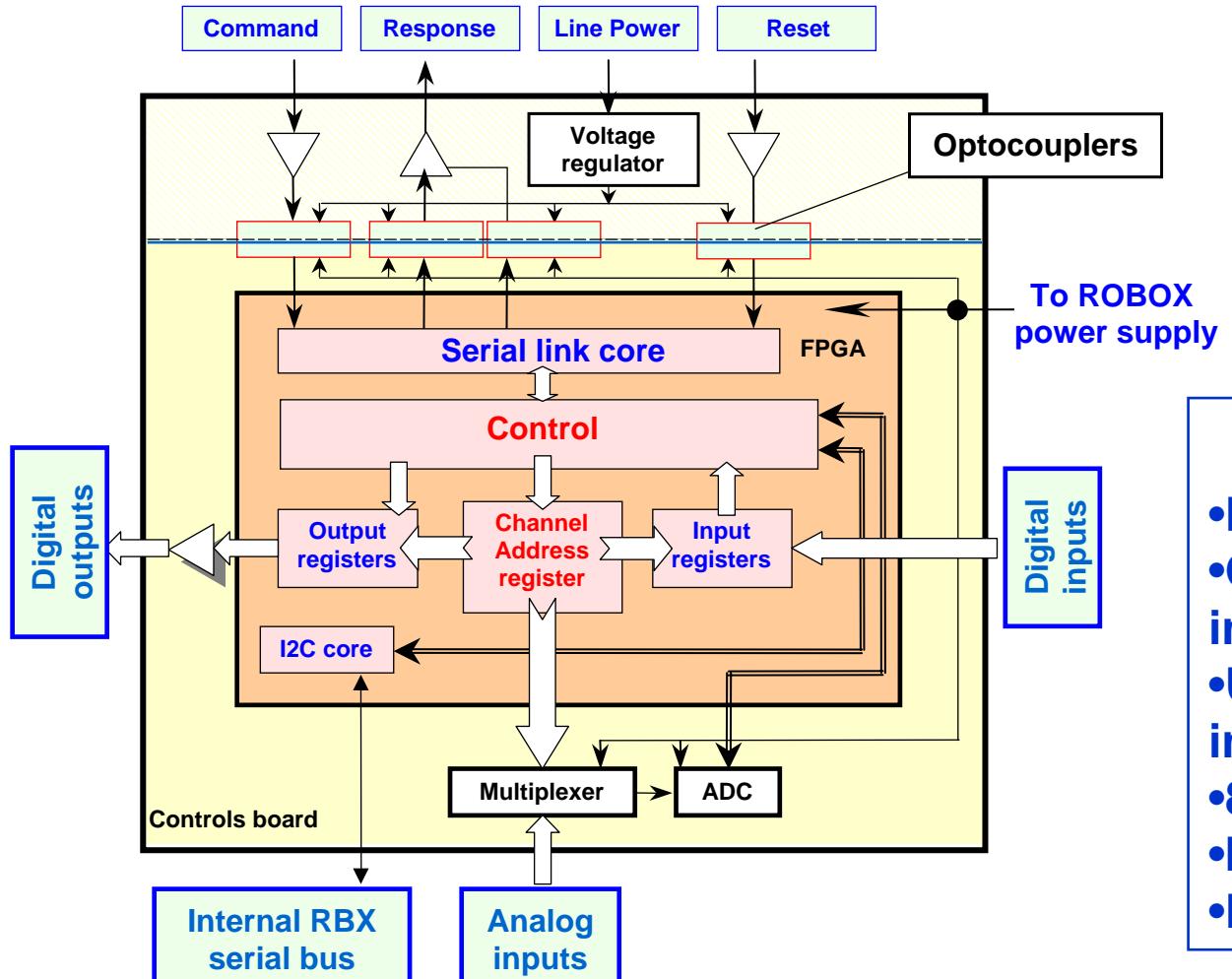
HCAL infrastructure HW

- ✓ •HV power supply monitoring
- ✓ •LV power supplies monitoring
- ✓ •LV + t⁰ on-board monitoring
- ✓ •LED calibration
- ✓ •Charge injection calibration
- ✓ •Parameter downloading
- ✓ •Source calibration
- ✓ •Laser calibration
- ? •HF radiation monitoring



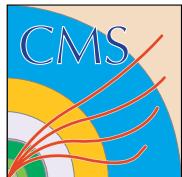


CCM structure

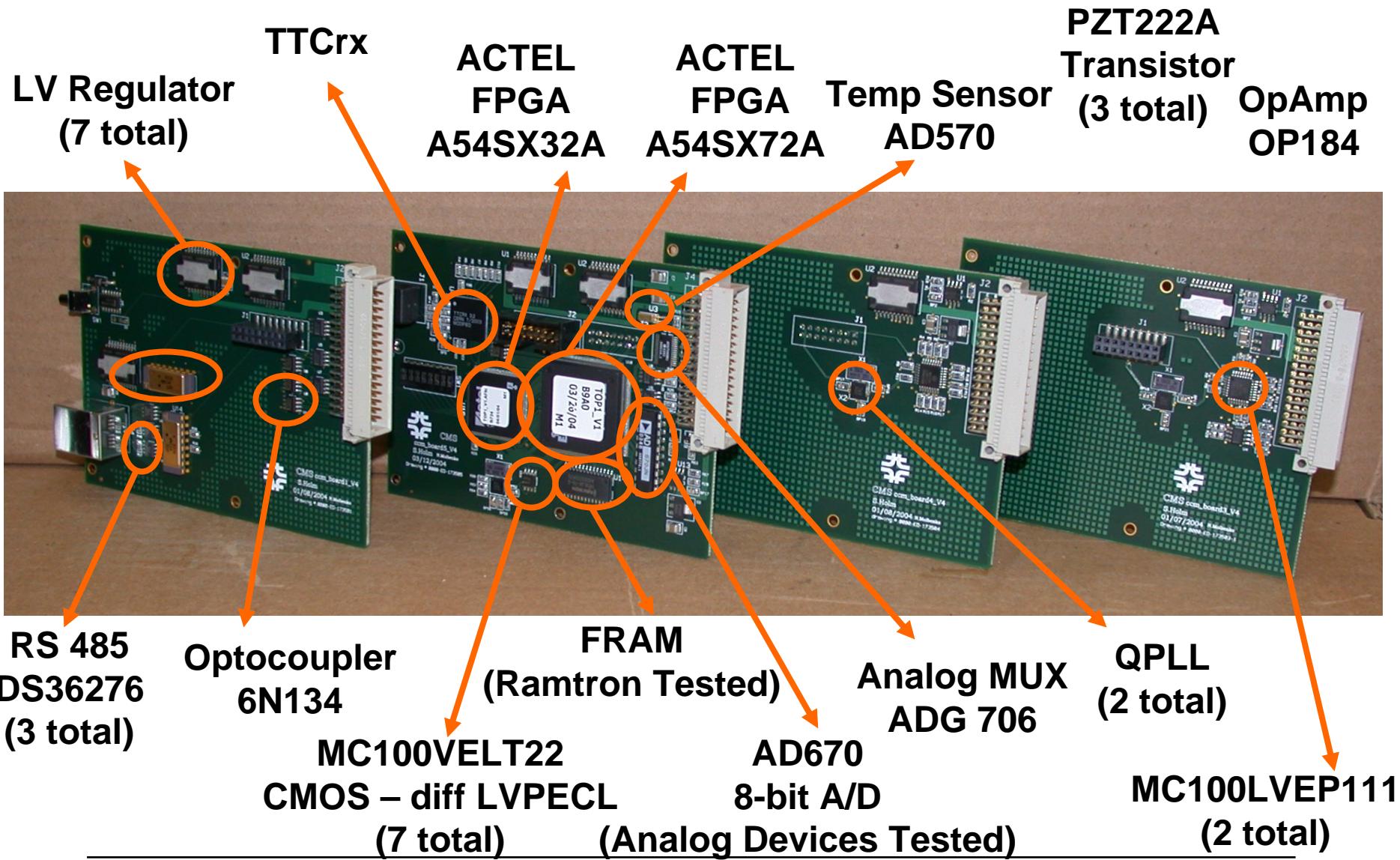


CCM

- Bipolar FPGA
- Optically insulated interface
- Up to 16 analog inputs
- 8 bit ADC
- I²C interface
- Digital I/O

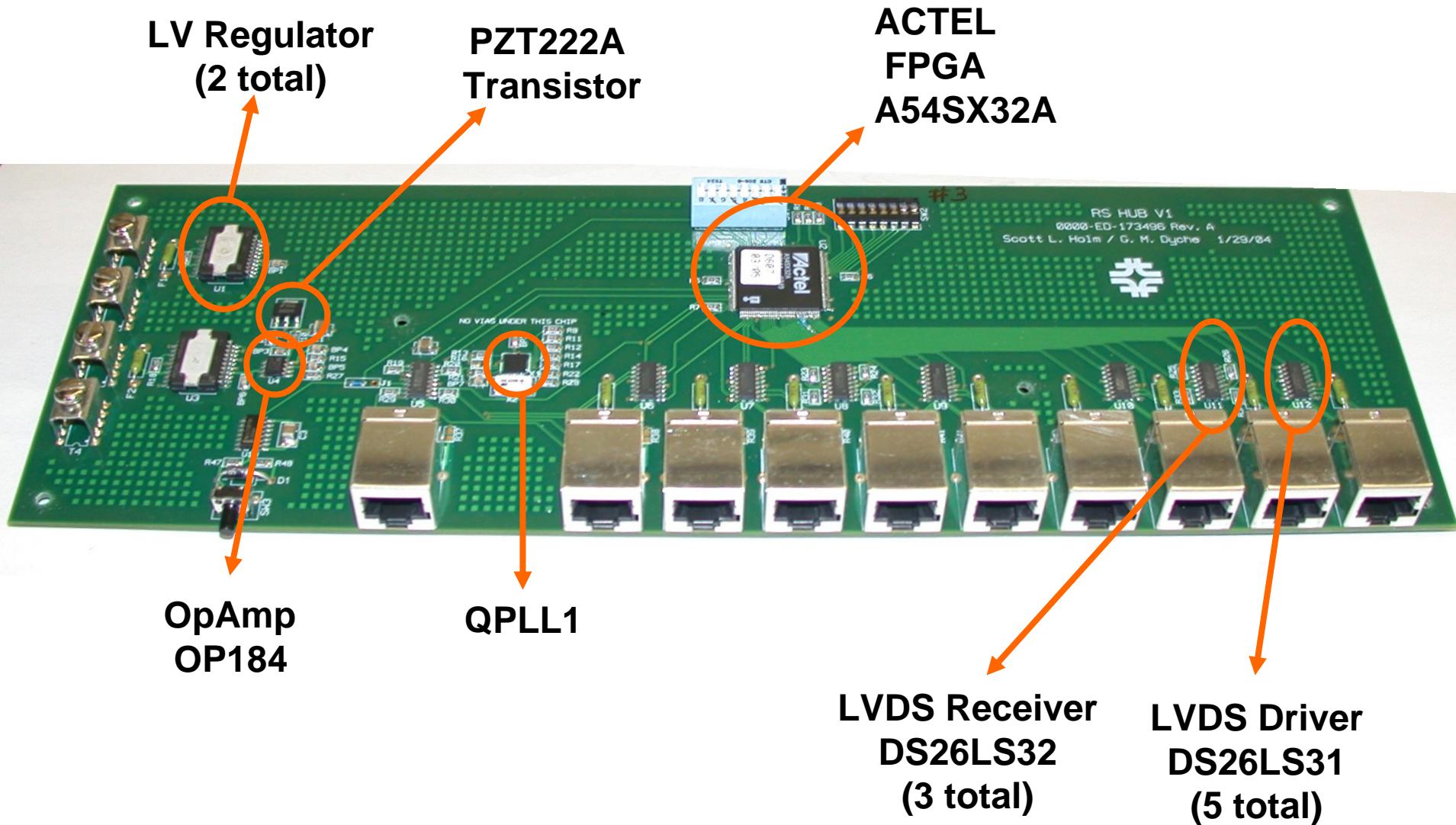


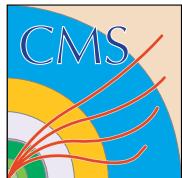
Control Clock Monitor





RS/RS Custom Hub





Custom Hub

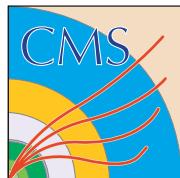




RBX parameters

FNAL/JINR (Sergueev)

- **Hardware: custom hubs, CCM**
- **3 main run modes (source,laser,beam)**
- **132 RBX having ~ 100 bytes each (TTC Rx, pedestal, delay, HV, BV)**
- **This gives 13.2 Kbytes per run mode**
- **Server/clients tested at H2/SX5**
- **Configuration tool, tester, debugger**



CCM configuring tool

Configuration builder

File Common map

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15F	15R	16F	16R
HBPhi1	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	
HBPhi2	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	
HBPhi3	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	
HBPhi4	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	
	Cell1	Cell2	Cell3	Cell4	Cell5	Cell6	Cell7	Cell8	Cell9	Cell10	Cell11	Cell12	Cell13	Cell14	Cell15	Cell16	Cell17	Cell18

Download to RBX Build sls only nonZero Selected All cells

QIE delay value QIE pedestal value

0	1	2	3	4	5	6	7
8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31

0	1	2	3	4	5	6	7

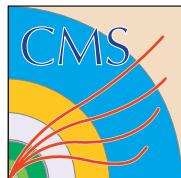
Delays Pedestals

SLS files directory

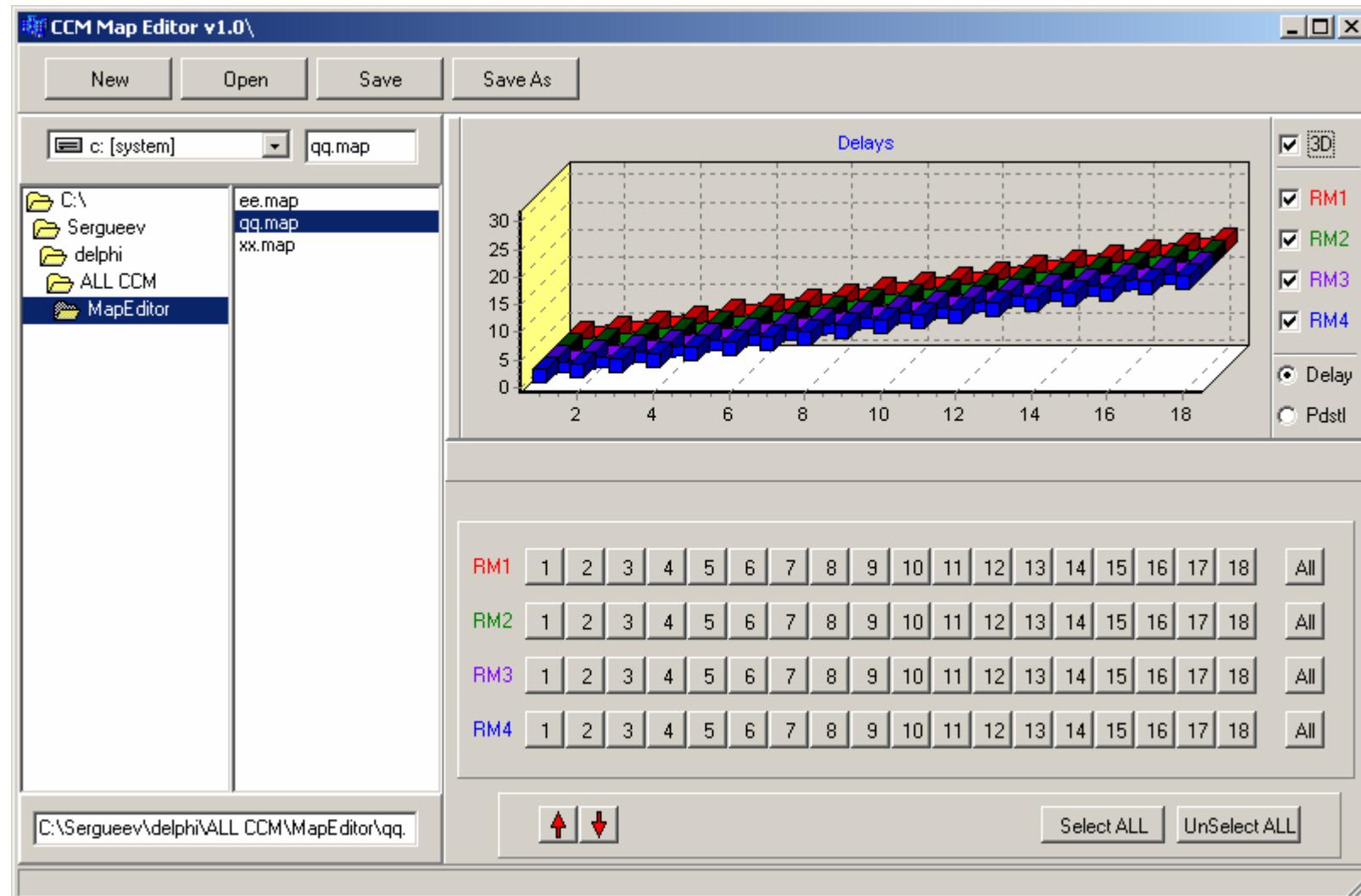
- C:\
- Sergueev
- delphi
- ALL CCM
- ConfigBuilder
- CPP test of map t
- test of map to sls
- c: [system]

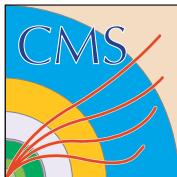
Map file - C:\Sergueev\delphi\ALL CCM\ConfigBuilder\1.map

Twr	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15F	15R	16F	16R	1
PHI	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3
Dly	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Ped	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5



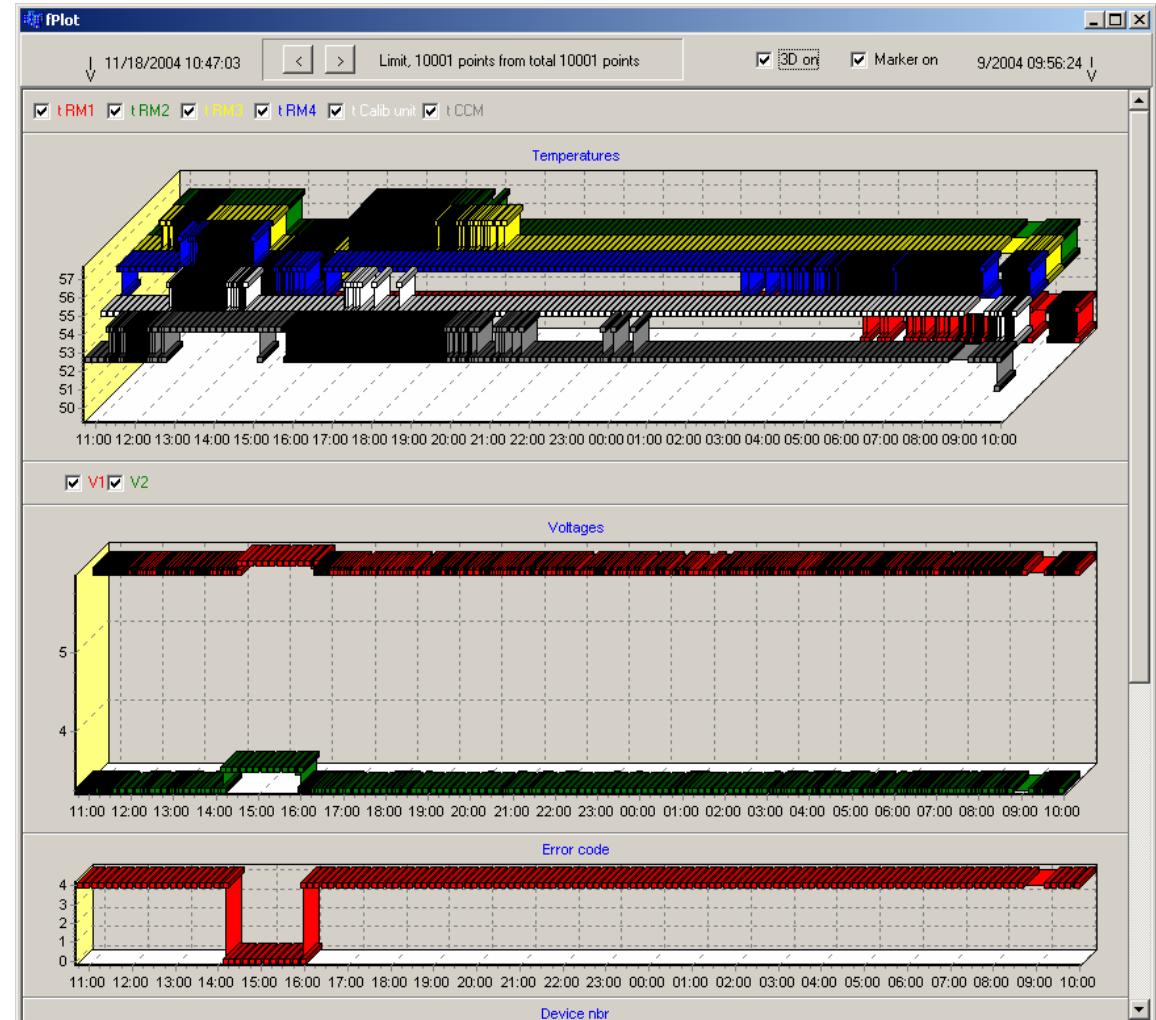
Map/Delay editing tool

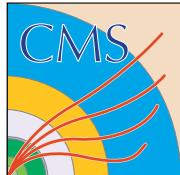




V,I, Temperature monitor

- 6 Temp Sensors
- 2 V, 2 I
- CCM digitizes
- Read out through RS links
- Available to expert clients and DCS via DIM for status, trending and alarms

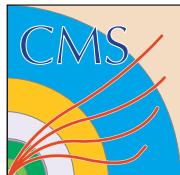




Migration to PVSS

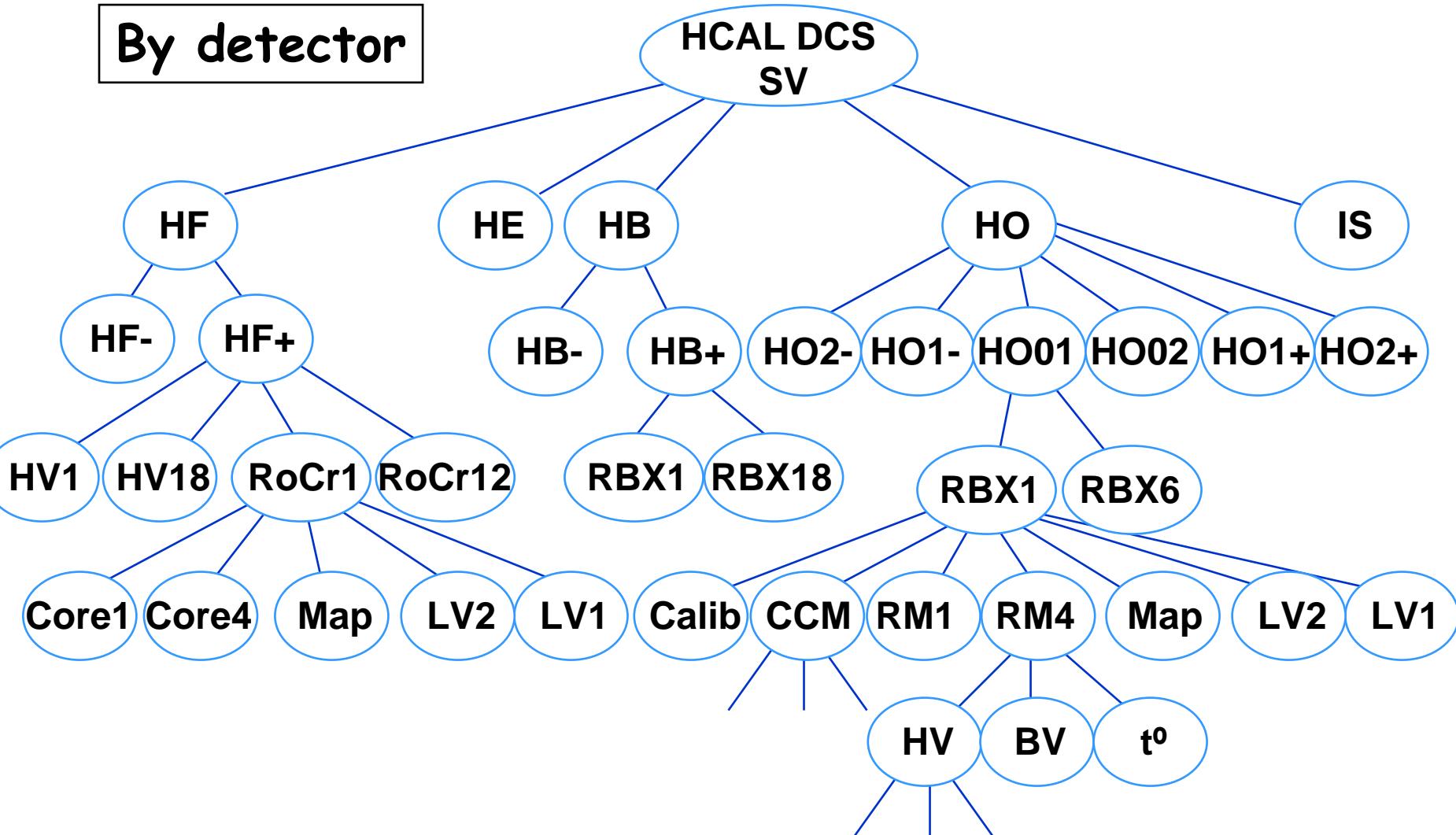
FNAL/JINR (Sergueev)

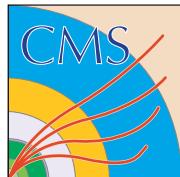
- **Define partitions (hierarchy)**
- **FSM tools (state definitions/transitions)**
- **Start development Jan '05**
- **HCAL dedicated integration Feb'05**
- **Functioning prototype by Jun '05**
- **Ready for the slice/magnet test in common mode**



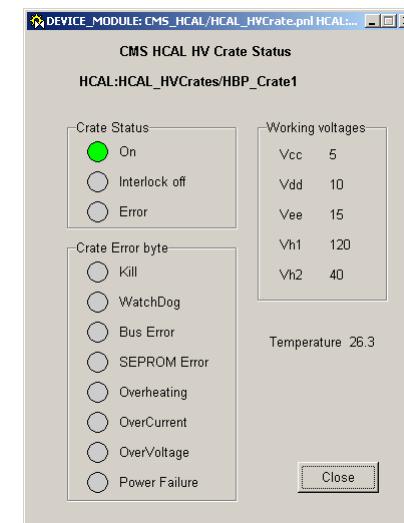
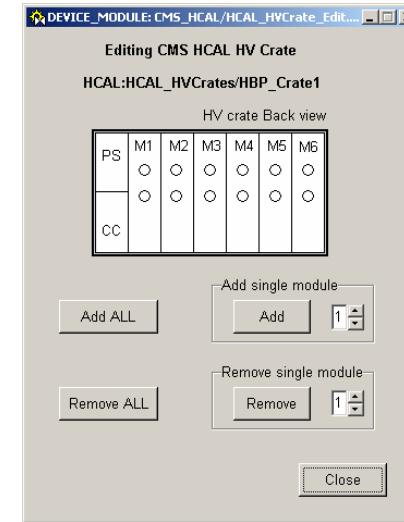
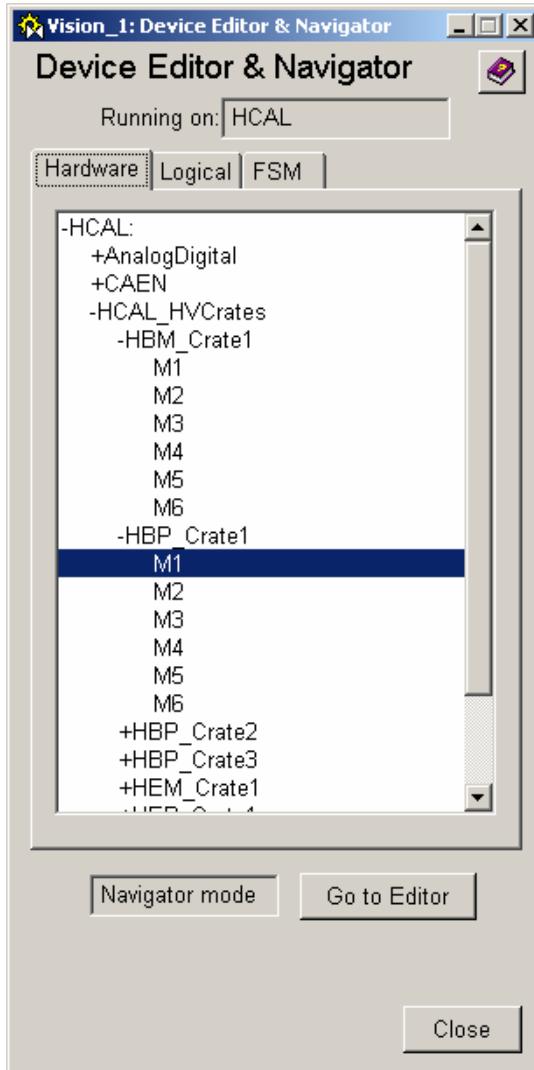
Hardware Partitions

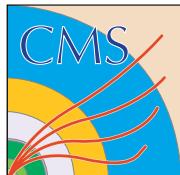
By detector





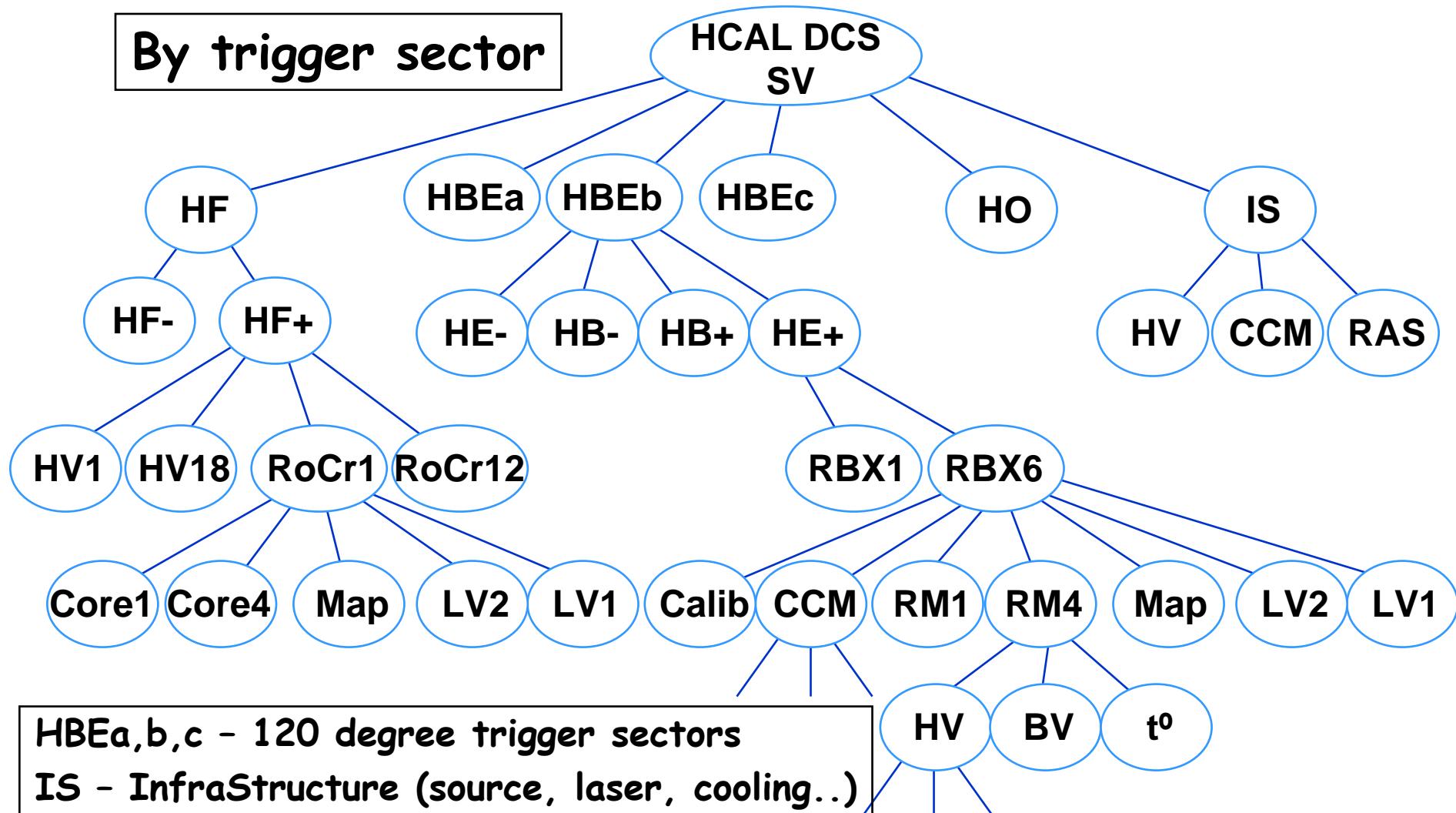
Hardware Tree

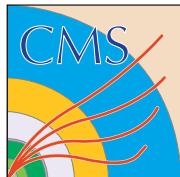




Logical & FSM Partitions

By trigger sector





Logical/FSM

Vision_1: Device Editor & Navigator

Device Editor & Navigator

Running on: HCAL

Hardware | Logical | **FSM**

-HCAL:
-HCAL_DCS
-HB \bar{e} a
-HBM
-HBM_Wedge1
 HB \bar{e} a/HBM/Wedge1/HV
 HB \bar{e} a/HBM/Wedge1/RBX
+HBM_Wedge2
+HBP

Start/Restart All | Stop All

DIM DNS NODE: pcuscms19.cern.ch

Navigator mode | Go to Editor

Close

HBea/HBP/Wedge1/RBX: HCAL:Manager2

Device RBX State ON ✓

15/06/2005 10:54:43

CERN

RBX Name: HCAL:HCAL_RBxs/HBP_RBX1

Status 1 Response 4

QPLL1 err 1 QPLL2 err 1

V 5.0 5.76 V 6.5 3.95

iRM1 35.85 iRM2 34.34

iRM3 32.83 iRM4 32.83

iCalib 32.83

CCM 31.32

CCM Nbr 1 Default command HB Norm 7

Messages

DEVICE_MODULE: CMS_HCAL/HCAL_HVModule.pnl HCAL:HCAL_HVCrates/HBP_Crate1/M1 in MODE_NAVIGATOR

CMS HCAL HV Module HCAL:HCAL_HVCrates/HBP_Crate1/M1

Module status byte

- HV On
- Interlock off
- Overcurrent
- OverVoltage

Channels summary

- HV On
- Ready
- Ramping Up
- Ramping Dn
- Bit 3
- Overcurrent
- OverVoltage
- Zeroed

Channels status

HPD1	HPD2	HPD3	HPD4
Actual voltage, V 0.000 4000	Actual current, uA 0.000 0.000	Voltage setting, V 100 4000	100.00 4000
100 4000	0.000 0.000	100 4000	0.000 0.000
100 4000	100 4000	100 4000	100 4000
100 4000	100 4000	100 4000	100 4000

BV value

HPD1	HPD2	HPD3	HPD4
100 4000	100 4000	100 4000	100 4000
4000	4000	4000	4000
100	100	100	100

HV value

HPD1	HPD2	HPD3	HPD4
100 4000	100 4000	100 4000	100 4000
4000	4000	4000	4000
100	100	100	100

Channels status

HPD1	HPD2	HPD3	HPD4
HV On Ready Ramping Up Ramping Dn			
Bit 3 Overcurrent OverVoltage Zeroed	Bit 3 Overcurrent OverVoltage Zeroed	Bit 3 Overcurrent OverVoltage Zeroed	Bit 3 Overcurrent OverVoltage Zeroed
100 4000	100 4000	100 4000	100 4000

Limits

BV limit 204.75 V BV current limit 7.52 uA HV limit 12456 V HV current limit 40.95 uA

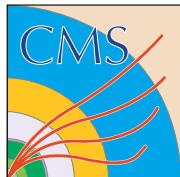
Ramp Up / Ramp Down speeds

Actual	Setting
RampUp speed HV, V/s 8.00	8
RampDn speed HV, V/s 8.00	9
RampUp speed BV, V/s 640.00	600
RampDn speed BV, V/s 640.00	512

HV ON **HV OFF**

Take actuals **Set ramps**

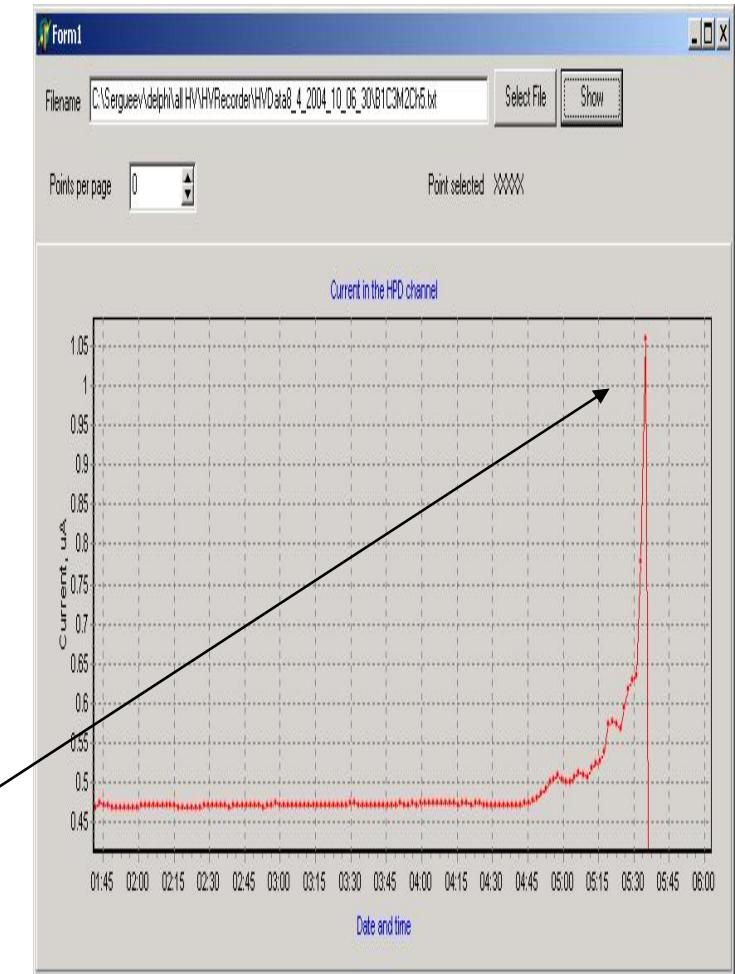
Close

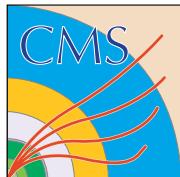


HV monitoring

FNAL/JINR (Sergueev)

- Custom PS for HV+BV and for HF PMTs (2 types of HV module)
- HO+HB+HE-108 RBXs, 18 HV PS crates
- HF – 72 channels, 2 HV PS crates
- RS-485 communication
- DIM Server/Client tested
- Monitoring exercised at H2





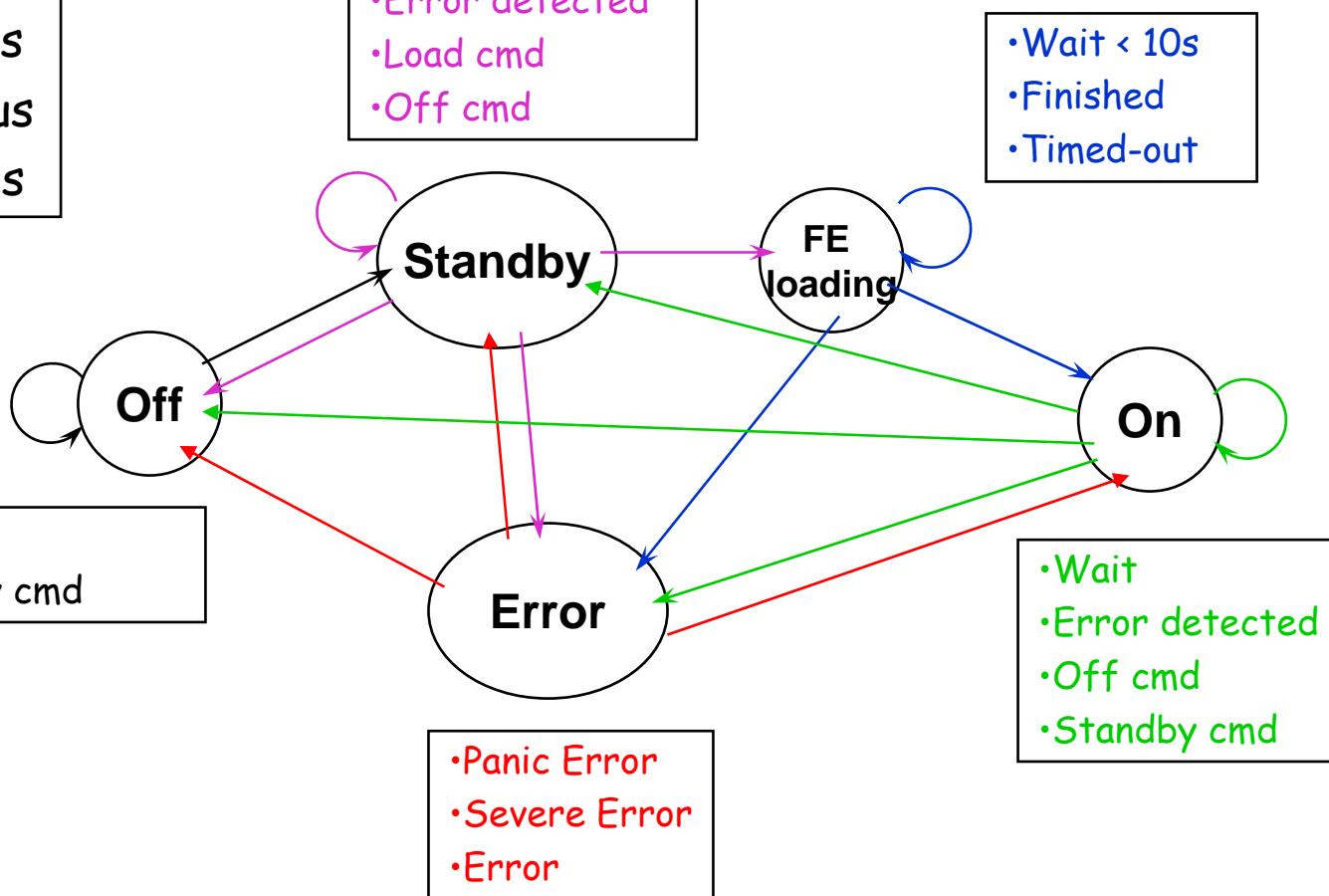
HCAL DCS states

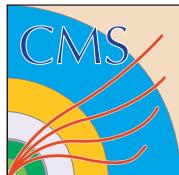
Signals:

- Commands
- LV status
- HV status
- FE status

- Wait
- Error detected
- Load cmd
- Off cmd

- Wait < 10s
- Finished
- Timed-out

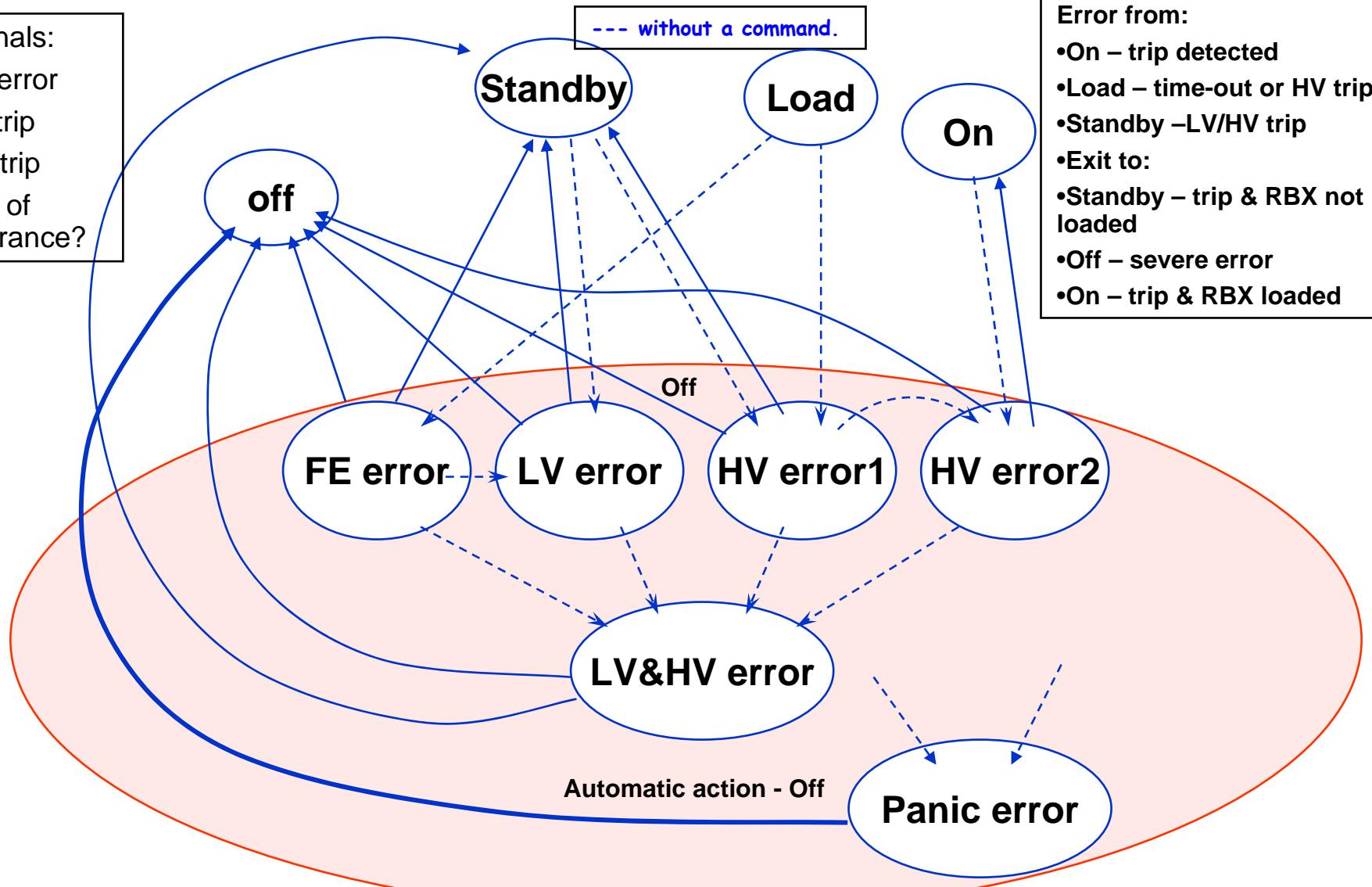


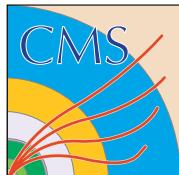


Error states

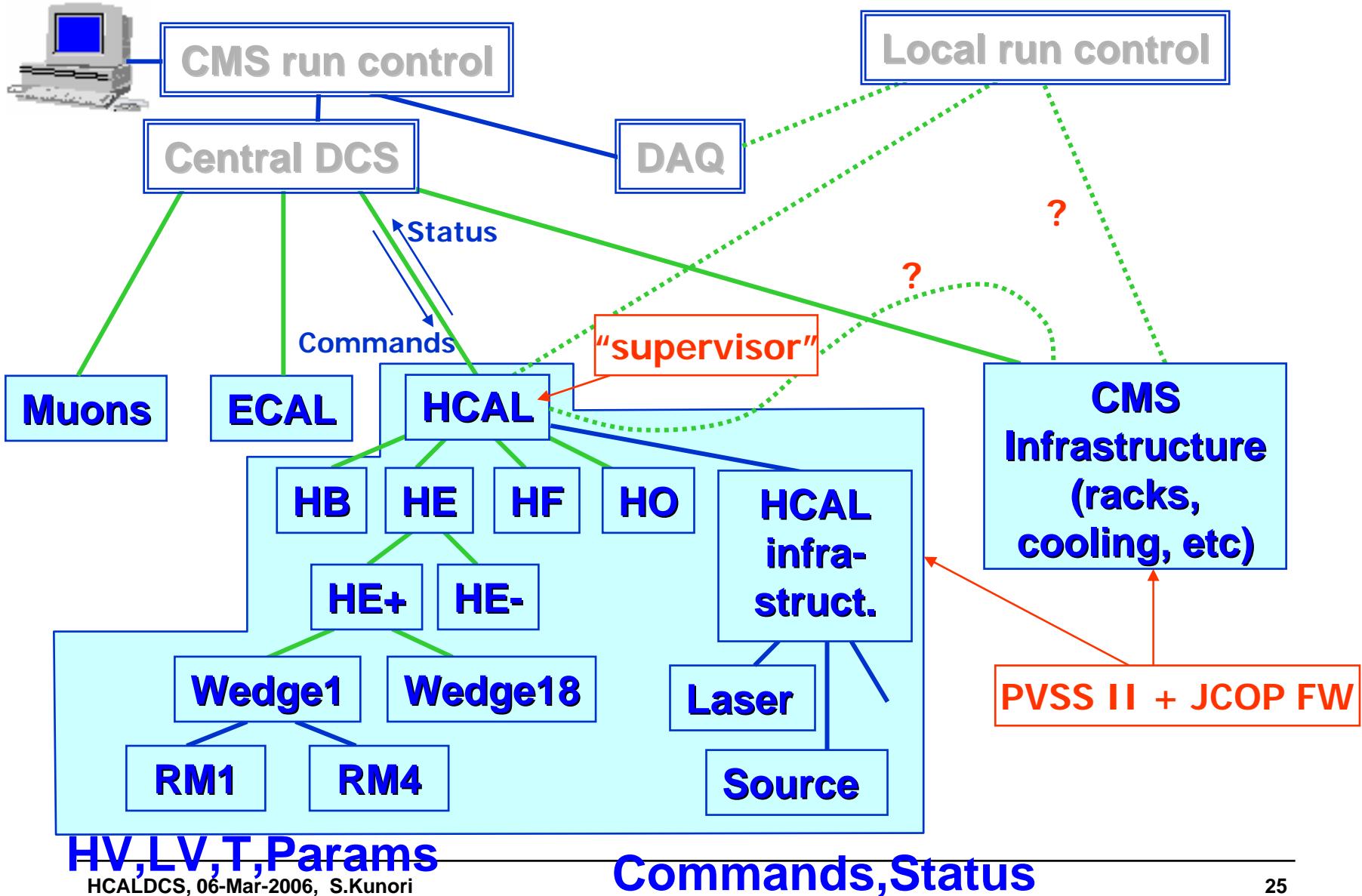
Signals:
FE error
LV trip
HV trip
Out of tolerance?

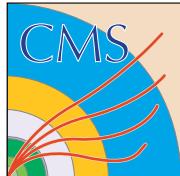
--- without a command.





Common and partitioned modes





Communications & Hardware Status

Rocket ports: All delivered, install as needed.

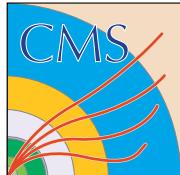
Custom Hubs: All delivered, installed at HE-

LAN Cables: delay of CERN delivery

- RBX/CCM - done for HE-
- HV - Install as needed
- LV - CANbus + Interlock (use LAN cables) done for HE-

Other: HE- only

- Patch panels in development
- RA source – controller to drives, cables installed.
- Laser – fibers installed



Software Status

- Jan 05 - replace C++ emulator with PVSS
 - DIM communication with Run Control
 - RBX parameters (local config DB)
 - RBX T,V
 - HV
- Feb 05 - state definitions and dedicated HCAL integration
- Feb 05 - source driver DIM servers in C++
- Dec 04 - laser DIM servers in BC++
- Mar 05 - source control in PVSS (July)
- Apr 05 - laser control in PVSS (July)
- May 05 - LV control/monitor in PVSS (Nov)
- Jun 05 - HCAL DCS Integration with JCOP FW (HV, FE), completed



Plans/Issues

- Systems need exercising soon.
- Debugging hardware and/or software?
- How to run in partitioned mode?
- Integration of components with *new RC*